

5 CLAIMS

1. A method for simultaneously measuring ciliary beat frequency and metachronal wave frequency simultaneously in a sample of native epithelia or cell cultures, such method comprising the steps of:

10 illuminating said sample with an illuminating light beam;
detecting light backscattered from the sample surface with a microscope system; and
analyzing the backscattered light with a real-time analysis system.

2. The method of claim 1 in which the illuminating light beam is laser light optically expanded to increase its focal depth.

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3. The method of claim 1 comprising a further step in which the illuminating light beam is optically split by a beam splitter such that the transmitted beam is impinged on a piece of teflon and the reflected beam is directed along the excitation path of the microscope objective.

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4. The method of claim 3 comprising a further step in which the reflected beam produced by the beam splitter is split by another beam splitter such that the reflected beam is directed to an eye-piece for visualization and the transmitted beam is focused by the microscope objective to the sample.

25 5. The method of claim 1 comprising a further step in which backscattered light from the sample and a random scatterer are mixed.

- 5 6. The method of claim 5 comprising a further step in which the mixed light is collected by
a photon counting photomultiplier tube.
- 10 7. The method of claim 1 comprising a further step in which the signals emitted from the
photomultiplier tube are analyzed to produce simultaneous measurements of
metachronal wave frequency and ciliary beat frequency.
- 15 8. The method of claim 1 in which the analysis to produce simultaneous measurements of
metachronal wave frequency and ciliary beat frequency comprises the steps of:
performing real-time time-scale wavelet transformation of the time series photon count
data; and performing real-time Hilbert transformation of the time series photon count
data.